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Sources of Data and Expertise for Environmental Factors Relevant to Amphibious Operations

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ABSTRACT

In the planning and conduct of amphibious operations it is necessary to have knowledge of a range of environmental variables, such as sea states, surf zone width and wave heights, beach composition, and bathymetry. Before embarking on a research program it seemed worthwhile to survey the institutions and personnel who already have expertise in the gathering and analysis of relevant environmental data types for Australian waters, and in their modelling and forecasting. The findings are presented here. The institutions which have data holdings are also reviewed and a considerable bibliography of papers, reports and books is presented. The primary purpose of this report is to be a reference document, both for DSTO and for interested ADF personnel.

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Executive Summary

The planning and conduct of amphibious operations requires knowledge of a range of environmental variables, such as:

Surface wave characteristics;
Large scale currents;
Nearshore currents (which includes those generated by waves, wind and tides);
Bathymetry;
Beach morphology data;
Nearshore sediment types;
Distributions of marine growth;
Water turbidity.

A considerable range of data and expertise exists within Australia on the environmental variables which are relevant to amphibious operations. There are data gatherers and analysers, data archivers, builders of mathematical models and forecasters. In this report a survey is presented of the personnel and institutions with relevant expertise so as to provide a reference document, both for DSTO and for interested ADF personnel.

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1. Introduction

For amphibious operations, as is common with all military operations, knowing what environmental conditions to expect prior to an operation can literally be the difference between success and failure. Environmental data is needed in two main ways. One is to provide a data base of both those factors which vary very little over time, such as seabed composition, and those which vary significantly with time, such as sea states, so as to determine the likely range of conditions to be expected during a planned operation. The other requirement is for data immediately before or even during an operation.

The marine data types seen as being relevant to amphibious operations include:

Surface wave characteristics (which includes offshore and nearshore)
Large scale currents
Nearshore currents (which includes those generated by waves, wind and tides)
Bathymetry
Beach morphology data
Nearshore sediment types
Distributions of marine growth
Turbidity

This report will outline the personnel in Australia with expertise in the acquisition and analysis of each of these data types, as well as those with expertise in their mathematical modelling. The institutions with holdings of each data type, especially for northern Australia, will also be listed. The bibliography (Section 12) contains a list of references. While the authors have attempted to be as thorough as possible it cannot be claimed that this report is totally exhaustive. In any active scientific field new initiatives are arising all the time and particular individuals or institutions may have been overlooked unintentionally. However the authors believe that this report covers most of the relevant personnel and institutions. A complementary report on sources of environmental data relevant to mine warfare is Mulhearn (1999).

2. Surface Wave Characteristics

Companies and organisations with expertise in obtaining or analysing surface wave data have already been listed in Hamilton (1997). He also reviewed and listed data holdings on waves, for the Australian area. His treatment will not be repeated here. Wave models have been reviewed in Andrew (1999). People who have expertise in obtaining and analysing surface wave data or mathematical modelling of waves include:

Associate Professor Michael Banner, University of NSW, (wind wave generation)
Dr E.S, Benilov, University of NSW, (non-linear waves and wave scattering)

Dr Peter Blennerhassett, University of NSW, (surface wave generation)
Dr Richard Brinkman, Australian Institute of Marine Science, Townsville
Douglas Bruce, Coastal Environment Pty Ltd
Steve Buchan, Weather News International
Dr Derek Burrage, Australian Institute of Marine Science, Townsville
Ms Diana Greenslade, Bureau of Meteorology Research Centre, Melbourne (wave modelling)
Professor Cedric Griffiths, Department of Petroleum , University of Adelaide
Ms Debbie Cox, University of NSW (surface wave modelling)
Dr Roger Grimshaw, Monash University, Clayton, Victoria
Dr Thomas Hardy, James Cook University, Townsville
Bruce Harper, System Engineering Australia
Professor Mal Heron, James Cook University, Townsville (HF Radar)
Dr John Hsu, University of Western Australia (waves)
Dr Michael Hughes, Department of Geology & Geophysics, University of Sydney, (wave modelling)
Richard Lailey, Weather News International
Mr Jason McConochie, James Cook University, Townsville
Dr Brendan T McGann, Curtin University
Dr W.D. McKee, University of NSW (current and wave interactions)
Mr Lou Mason, James Cook University, Townsville
Mr Brett Miller, University of NSW (surface wave modelling)
Mr R.C.Nelson, University of NSW (wave shoaling and breaking)
Dr Brian Noye, University of Adelaide (waves)
Dr Charitha Pattiaratchi, University of Western Australia (waves)
Arthur Shrimpton, Weather News International
Dr Bill Peirson, University of NSW (surface wave generation)
Dr Graham Warren, Oceanographic Systems Development, Bureau of Meteorology, Melbourne (wave modelling)
Dr A.T.Webb, Australian Defence Forces Academy (surface wave climatology)
Professor Ian Young, University of Adelaide, (wave modelling)

For institutions holding data see Hamilton (1997).

3. Large Scale Currents

Horizontal currents in the ocean are normally measured by:

1. Aanderaa (rotary) current meters,
2. Acoustic Doppler Current Profilers (ADCP's) (either ship, mooring or bottom mounted)
3. Lagrangian Neutrally Buoyant floats, or
4. Electromagnetic current meters

3.1 People

People who have expertise in obtaining and analysing current data or in modelling currents include:

Dr John Bennet, Flinders University, Adelaide
Dr Derek Burrage, Australian Institute of Marine Science, Townsville
Dr John Bye, Flinders University, Adelaide
Dr Michael Coates, Deakin University (laboratory oceanographic modelling)
Dr Peter Craig, CSIRO Division of Marine Research, Hobart
Dr George Cresswell, CSIRO Division of Marine Research, Hobart
Dr R.S. Gardiner-Garden, University of NSW (Leeuwin Current)
Professor Roger Grimshaw, Monash University
Dr Clifford Hearn, Australian Defence Force Academy
Dr Peter Holloway, Australian Defence Force Academy
Professor Jason Middleton, University of NSW
Dr John Middleton, University of NSW
Dr Rick Nunes Vaz, Australian Defence Force Academy
Dr Charitha Pattiaratchi, University of WA
Mr Alan Pearce, CSIRO Division of Marine Research, W.A.
Dr Steve Rintoul, CSIRO Division of Marine Research, Hobart
Dr Brian Sanderson, University of NSW
Dr Neville Smith, Bureau of Meteorology
Professor Matthias Tomczak, Flinders University, Adelaide
Stephen Walker, CSIRO Division of Marine Research, Hobart
Dr Susan Wijffels, CSIRO Division of Marine Research, Hobart

3.2 Institutions

Data on currents are held by the following institutions:
The Australian Defence Force Academy for the Northwest Shelf of Australia, (Contact: Dr Peter Holloway);
The Australian Institute of Marine Science for the Great Barrier Reef, Torres Strait, Exmouth Gulf and elsewhere;
Weather News International for numerous locations, including Bass Strait, and the approaches to Dampier and Port Headland;
Woodside Petroleum for Mermaid Sound and the approaches to Dampier;
CSIRO for the whole of Australia's coastal fringes as well as offshore extremities;
Australian Oceanographic Data Centre (AODC);
The RAN Hydrographer for tidal stream data from many ports.

3.3 Tidal Current Modelling

Individuals with expertise in the modelling of tidal currents include:

Dr Lance Bode and Dr Luciano Mason, Department of Civil & Systems Engineering, James Cook University, Townsville;
Dr John Middleton, School of Mathematics, University of New South Wales;

A number of other institutions have expertise in modelling tidal currents including:

Centre for Water Research, University of Western Australia;
Australian Institute of Marine Science, Townsville;
National Tidal Facility, Adelaide.

4. Nearshore Currents

Here the term nearshore currents includes both long-shore currents and rips. People who have expertise in measuring and calculating nearshore velocities include:

Dr Michael Hughes, University of Sydney
Mr Lex Nielsen, University of NSW, Sydney
Dr Peter Nielsen, University of Queensland
Dr Graham Symonds, Australian Defence Force Academy, Canberra
Dr Ian Turner, University of NSW, Sydney

Note that the areas of nearshore currents, beach morphology and sediment transport are closely related, so that expertise in one really implies expertise in the other two.

5. Bathymetry

5.1 People

The main agency for bathymetric data around Australia is the RAN Hydrographic Office in Wollongong. Other people or agencies having expertise in the coastal bathymetry of Australia include:

George Bernadell, Australian Geological Survey Organisation, Canberra
Cameron Buchanan, Australian Geological Survey Organisation, Canberra
The LADS Corporation, for laser airborne depth sounding.

5.2 Data Sources

Sources of digital bathymetric data for the Australian region include:

Digital Bathymetry Data Base 5 minutes (DBDB5), downloadable from the worldwide-web;
Earth Topography#5, downloadable from the worldwide-web;
GEBCO-97, a CD from the British Oceanographic Data Centre;
The RAN Hydrographer;
30 second bathymetry maps of the Australian region from the Australian Geological Survey Organisation.

5.3 Coastline Data Sets

Organisations with expertise in coastline data sets include the RAN Hydrographer and the Australian Land Information Group (AUSLIG), Department of Industry, Science and Resources. The different data sets that can be used to depict the Australian coastline include:

World Data Bank II (or the CIA Data Bank) 1:2,000,000
World Vector Shoreline 1:250,000
World Coast Line 1:5,000,000
GSHHS (Global Self-consistent Hierarchical High resolution Shoreline database)
GEODATA COAST (from AUSLIG) 1:100,000
GEBCO-97
Global Relief Data (from the NOAA National Data Centre)

6. Beach Morphology

6.1 People

People with expertise in measuring and analysing nearshore morphology include:

Dr Peter Cowell, University of Sydney
Dr Gerhard Masselink, University of Western Australia
Professor Andy Short, University of Sydney

Note that the areas of nearshore currents, beach morphology and sediment transport are closely related, so that expertise in one really implies expertise in the other two.

6.2 Data Sources

James Cook University has some aerial photographs which could be used to infer morphology, as does Professor Andy Short and AUSLIG.

Professor Short has set up the Australian Beach Safety and Management Program Database which, when complete, will cover all Australian beaches. It contains a wealth of information on the morphology of individual beaches (Web page: http://www.slsa.asn.au/web/slsa/slsaweb.nsf/SectionPage/Beach+Safety+and+Management). Short (1993, 1996 and 2000) reports on surveys of the NSW, Victorian and eastern Queensland coasts, respectively.

7. Nearshore Sediment Data

7.1 People

Personnel who have expertise in obtaining and analysing sediment data include:

Ray Brown, University of WA
Dr G Brunskill, Australian Institute of Marine Science
John Chappell, Australian National University
Professor Allan Chivas, University of Wollongong
Associate Professor M. Fahey, University of WA
Dr Peter Harris, Antarctic CRC, Hobart, Tasmania
Dr Chris Jenkins, Ocean Sciences Institute, Sydney University
Brian Logan, Alness Street, Applecross, WA 6153
Dr Bradley Opdyke, Australian National University
Peter Roy, Department of Geography, University of Sydney
Dr Victor Semeniuk, Journal of the Royal Society of Western Australia and private consulting firm in Perth [vcsrg@iinet.net.au]
Professor Andrew Short, Coastal Studies Unit, University of Sydney (expertise on beach forms)
Professor Chris Von Der Borsch (retired), School of Earth Science, Flinders University, Adelaide
Associate Professor Colin Woodroffe, University of Wollongong (particular expertise for northern Australian coastal waters)

7.2 Data Sources

Professor Andrew (Andy) Short is collecting sediment data for the swash and surf zone around the northern Australian coastline for Surf Lifesaving Australia and for DSTO. Professor Short has set up the Australian Beach Safety and Management Program Database which, when complete, will cover all Australian beaches. (Web page: http://www.slsa.asn.au/web/slsa/slsaweb.nsf/SectionPage/Beach+Safety+and+Management). Short (1993, 1996 and 2000) report on the surveys of the NSW, Victorian and eastern Queensland coasts, respectively.

The Australian Geological Survey Organisation (AGSO) has some sediment data for the northern Australian coastal zone, and the Australian Defence Forces has a Beachcomber data base. The Australian Institute of Marine Science holds sediment data for Exmouth Gulf, W.A. and has taken video transects of the bottom both within the Great Barrier Reef and off northwestern Australia. These could be very useful.

Galloway et al. (1984) outlines sediment data between the mid and high water marks derived from air photos. It also has data regarding vegetation distributions. An excellent review of sediment data for the Australian continental shelf is Harris et al. (1991). It has, however, little information on beaches.

The CSIRO Coastal and Marine Resources Information System (CAMRIS) Coastal Soils Data set has soil or sediment information in the coastal zone and was derived from the Atlas of Australian Soils (Northcote et al, 1960-68). The CAMRIS Australian Estuaries Data set contains information about the distribution and characterisation of estuaries around the Australian coastline. It was derived from the inventory of Australian estuaries prepared by Bucher and Saenger (1989).

The Ocean Sciences Institute Australian Seabed Database (AUSEABED), although not a coastal sediment data base, does have limited data shoreward of the 10m mark. The Australian Oceanographic Data Centre (AODC) holds a copy of this database.

CSIRO Division of Marine Research has some satellite data which may be useful for inferring nearshore sediment data. AGSO has developed some algorithms for doing this.

8. Distributions of Marine Growth

Only seagrass and mangroves are covered here. Little work has been performed on mapping distributions of macroalgae, such as kelp, in northern Australian waters.

8.1 Seagrass Communities

8.1.1 People

People with expertise in seagrass biology include:

Dr Ian Hahmdorf, Bureau of Resource Sciences
Dr Hugh Kirkman, CSIRO Division of Marine Research
Dr David W Klumpp, Australian Institute of Marine Science (d.klumpp@aims.gov.au)
Dr A.W.D. Larkum, University of Sydney (alark@bio.usyd.edu.au)
Brian Long (CSIRO Division of Marine Research, Cleveland, Queensland
Dr Laurence McCook, Australian Institute of Marine Science

Dr Eric Paling, Murdoch University(paling@essun1.murdoch.edu.au)
Dr Roland Pitcher (CSIRO Division of Marine Research, Cleveland, Queensland
Dr Peter Rothlisberg (CSIRO Division of Marine Research, Cleveland, Queensland
Dr Scoresby Shepherd, South Australian Research and Development Industry
Thomas Taranto, CSIRO Division of Marine Research, Cleveland, Queensland
Dr Mike van Keulen, Murdoch University

8.1.2 Data Sources

CAMRIS Seagrass Dataset contains information about seagrass distributions around Australia's coastline. Other information can be found from the publications in the Reference Section.

8.2 Mangroves

8.2.1 People

Personnel that have expertise in mangrove distributions around the Australian coastline include:

Catherine Lovelock, Australian Institute of Marine Science
Keith McGuiness, Northern Territory University
Darren Wilson, BHP

8.2.2 Data Sources

Australian Institute of Marine Science has data concerning mangrove distributions along the coast of northwestern Australia. The Australian Environmental Resources Information Network (ERIN) has distribution maps for mangroves (web address: http://www.environment.gov.au).

The Northern Territory Department of Lands, Planning and Environment is currently planning studies to map mangrove distributions around the Northern Territory.

9. Water Turbidity and Sediment Transport

Water turbidity is controlled by three factors: dissolved organic compounds; particles in suspension; living organisms of which the dominant ones are single celled algae or phytoplankton. In the nearshore region suspended particles are often the dominant source of water turbidity and calculation of their concentrations requires a knowledge of suspended sediment transport processes.

9.1 People

People who have expertise in measuring and calculating longshore sediment transport magnitudes include:

Dr Michael Hughes, University of Sydney
Dr Peter Nielsen, University of Queensland
Dr Charitha Pattiaratchi, University of Western Australia
Dr Peter Ridd, James Cook University
Dr David Walker, University of Adelaide

Note that the areas of nearshore currents, beach morphology and sediment transport are closely related, so that expertise in one really implies expertise in the other two.

9.2 Data Sources

The Australian Institute of Marine Science (AIMS) has water quality and suspended sediment concentration data in the vicinity of some reefs in the Great Barrier Reef and off Australia's northwest coastline. This was taken from 1990 to 1996 inclusive. AIMS also has turbidity data derived from NOAA satellites.

The Australian Oceanographic Data Centre has turbidity data for Australian waters, mostly as Secchi disc data. CSIRO Division of Marine Research, Hobart, also holds turbidity data. Most of the data held by these two organisations is not from locations close inshore.

CSIRO Division of Marine Research has a satellite data receiving system and some satellite data can be used for obtaining water turbidity data. An example of the methods which can be used is reported in Mulhearn (1995).

10. Datasets which Span Several Data Types

The Australian Spatial Data Directory seems to be able to extract many types of data (most importantly oceanographical) from numerous sources. It is located at (http://www.environment.gov.au/net/asdd/) and appears to have huge potential.

The National Geographic Information System (http://www.ngis.com.au/index.htm) has compiled many environmental data bases for the petroleum industry and may be consulted to determine which could be useful.

The Australian Coastal Atlas (http://www.environment.gov.au/marine/coastal_atlas/) is also a valuable source of coastal information, including data on beaches, vegetation, topography and infrastructure.

TOPO250K is a dataset which shows the following attributes about Australia: coastline; land usage; drainage networks; roads; railways; lakes; wetlands; relief.

TOPO101 is a dataset for Western Australia and shows coastlines and geomorphological type for the coastlines. The geomorphology data was captured from the Howard Jones dataset (Marine resources map of Western Australia) and were later verified by Ian Elliot (University of Western Australia). The coastline data came from the AUSLIG 1:100,000 coastline database.

The CAMRIS database has coastal wind data, coastal wave-rider buoy locations, Exclusive Economic Zone (EEZ) bathymetry, and tidal data.

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19. ABSTRACT

In the planning and conduct of amphibious operations it is necessary to have knowledge of a range of environmental variables, such as sea states, surf zone width and wave heights, beach composition, and bathymetry. Before embarking on a research program it seemed worthwhile to survey the institutions and personnel who already have expertise in the gathering and analysis of relevant environmental data types for Australian waters, and in their modelling and forecasting. The findings are presented here. The institutions which have data holdings are also reviewed and a considerable bibliography of papers, reports and books is presented. The primary purpose of this report is to be a reference document, both for DSTO and for interested ADF personnel.